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Neilson Lake Wetland Enhancement Project

P. E. Hengeveld and F. B. Corbould
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1.0 INTRODUCTION

The Peace/Williston Fish and Wildlife Compensation Program (PWFWCP) undertakes wetland inventories and enhancement projects as part of its mandate to enhance and protect wildlife species and habitat in the Williston Reservoir watershed (Davidson and Dawson 1990). The Neilson Lake wetland was assessed by PWFWCP and Ducks Unlimited (DU) biologists, and identified as one of the best opportunities for wetland enhancement and wildlife viewing in the Parsnip River drainage. This wetland is important because of its relatively high productivity potential and diversity of wildlife.

Prior to September 1995, Neilson Lake's water level was maintained by a 2 m high beaver dam. This beaver dam was in poor condition and could no longer sustain a secure, stable water level. A breach in the dam would have reduced the wetted area by 70%, leaving a small pond with only a narrow band of submergent vegetation. Neilson Lake also had a limited amount of emergent vegetation around its perimeter, which contributed to a lack of overwater and breeding-pair nesting areas for waterfowl.

Emergent and submergent vegetation generally needs exposed mineral soil to promote its growth. Wetlands can therefore benefit from cycles of flood and drought. Temporary drawdowns on lake water levels aerate basin soils, thereby enriching the vegetative rooting medium. By raising the water levels after vegetation has established itself, wetland communities have been enhanced. Emergent vegetation, such as sedges *(Carex spp.)*, cattails *(Typha latifolia)*, and bulrushes *(Scirpus spp.)*, provides food, protective shelter, and overwater nesting habitats for waterfowl. Taller emergent vegetation also acts as a visual barrier between waterfowl breeding-pair sites. Submergent vegetation, such as pondweeds *(Potamogeton spp.)*, smartweeds *(Polygonum spp.)*, bladderworts *(Utricularia spp.)*, and waterlilies *(Nuphar spp.}*, provides food for many waterfowl species. Both groups of vegetation also provide microhabitats for water invertebrates upon which numerous fish and wildlife species (including waterfowl) feed. Muskrats *(Ondatra zibethica)* eat cattails and use them and other emergent vegetation to make their lodges. Also, beavers *(Castor canadensis)* feed on the rootstocks of waterlilies.

The construction of a weir was proposed to stabilize lake water levels and provide water control capabilities. It was estimated that with the weir and establishment of other enhancements (level ditching and nesting structures), the Neilson Lake wetland could

potentially produce 150 young ducks and geese annually (DU unpubl. data). A more stable water regime and increased diversity and distribution of habitats would likely also benefit a number of other wildlife species, such as common loons *(Gavia immer)* shorebirds, aquatic furbearers, moose and bats. Proper management and maintenance of suitable vegetation and water levels will ensure the long term existence of this wetland for a wide variety of flora and fauna. Conserving the Neilson Lake wetland and increasing public awareness of its location will also provide tourism opportunities, through wildlife viewing and recreational activities.

This report documents the planning activities and enhancement work undertaken by the PWFWCP and DU to complete the Neilson Lake wetland enhancement project.

2.0 AREA DESCRIPTION

Neilson Lake is located in the southernmost corner of the Williston Reservoir watershed (Figure 1). It can be vehicle-accessed via Tallus Road, off Highway 97, 40 km north of the Chief Lake Rd/Highway 97 junction in Prince George.

The southwest corner of Neilson Lake, including the outlet creek and proposed dam site, is located on crown land (District Lot 1153 Cariboo) designated as part of the Summit Lake Forest Recreation Site (Ministry of Forests Recreation Reserve #1124) (Figure 2). This site was the former location of an old sawmill on the shore of Summit Lake, for which Neilson Lake was the mill's water source. An old railway bed for the railway that connected the mill to the BC Rail mainline still exists along the northwest side of the lake.

Adjacent waterbodies to Neilson Lake include Summit Lake, and three small seasonal sedge fens within a couple of kilometres. One seasonal creek enters Neilson Lake from the northeast, while the remainder of the lake's source of water comes from local runoff. An outlet creek (Neilson Creek) at the southwest corner of Neilson Lake flows 350 m west into Summit Lake. A beaver dam on this outlet has maintained the lake's water level at its current level for over fifteen years.

At normal operating levels (N.O.L.; 713.0 m a.s.l.), Neilson Lake covers 46.5 ha and has 4.7 km of shoreline. The wetland is dominated by an interior open water area surrounded by submergent vegetation, and a large fen of emergent vegetation at its eastern corner (Figure 3).

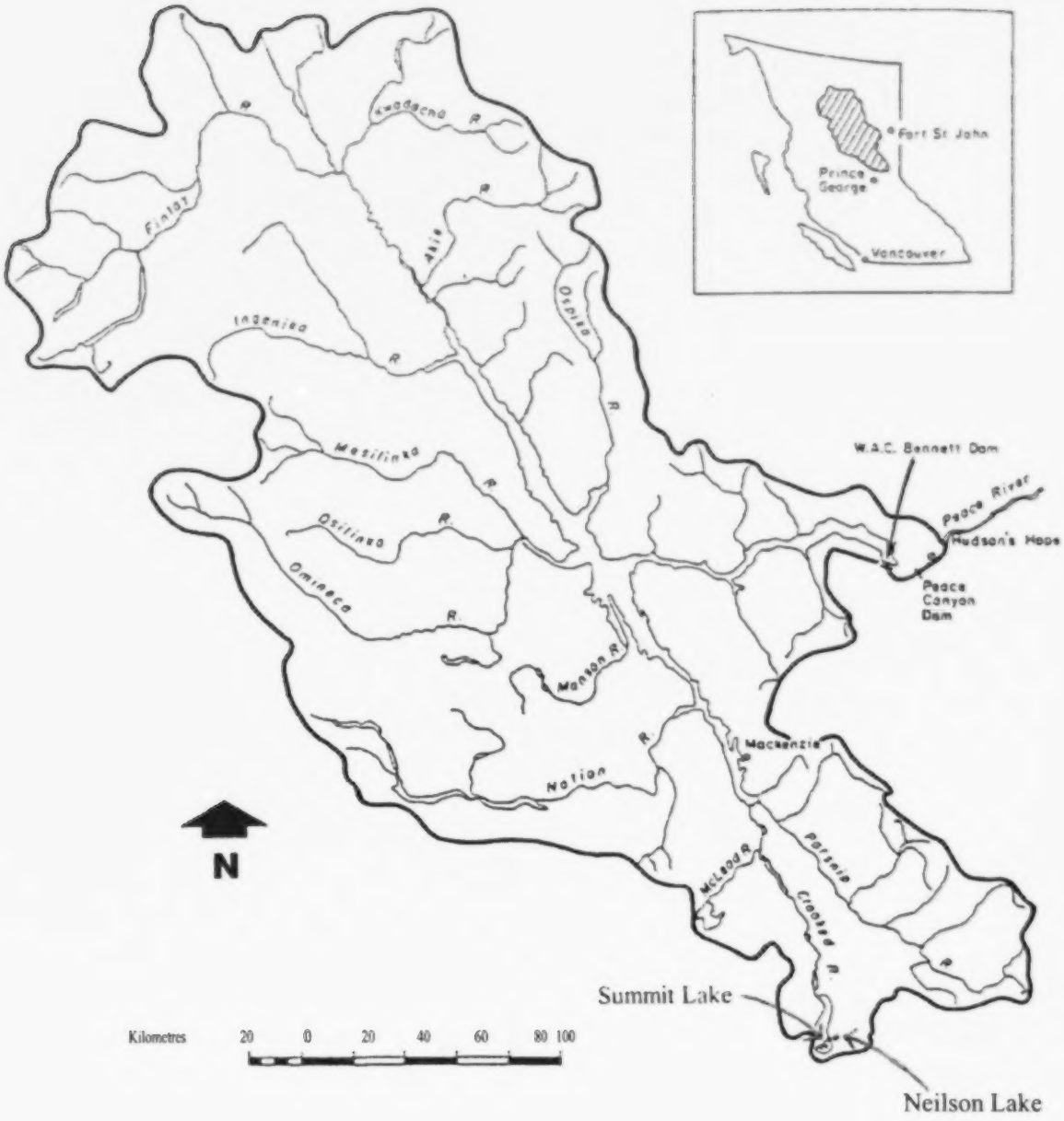


Figure 1. Location of the Neilson Lake wetland enhancement site within the Williston Reservoir watershed.

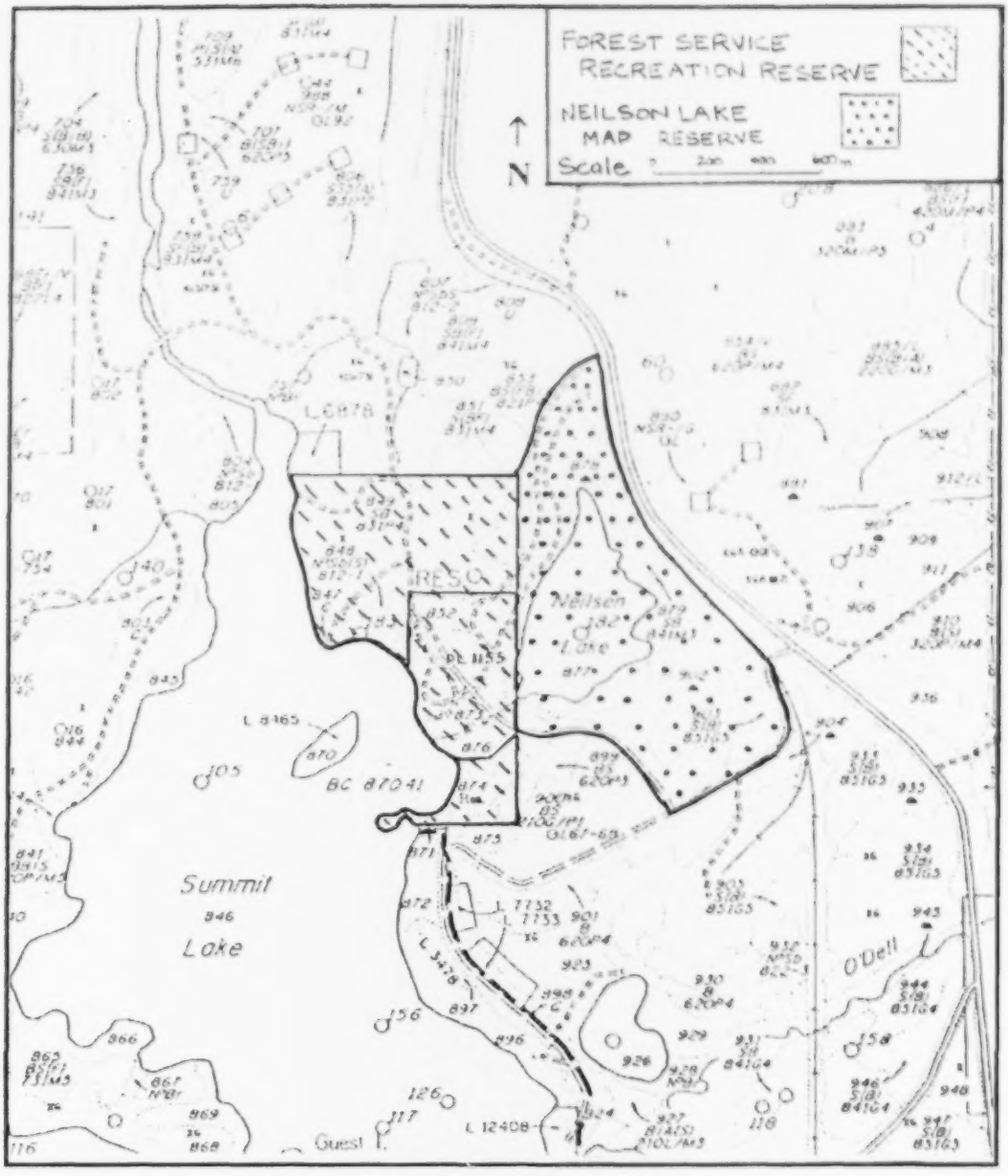


Figure 2. Map of Neilson Lake and the adjacent Summit Lake Forest Service Recreation Site.

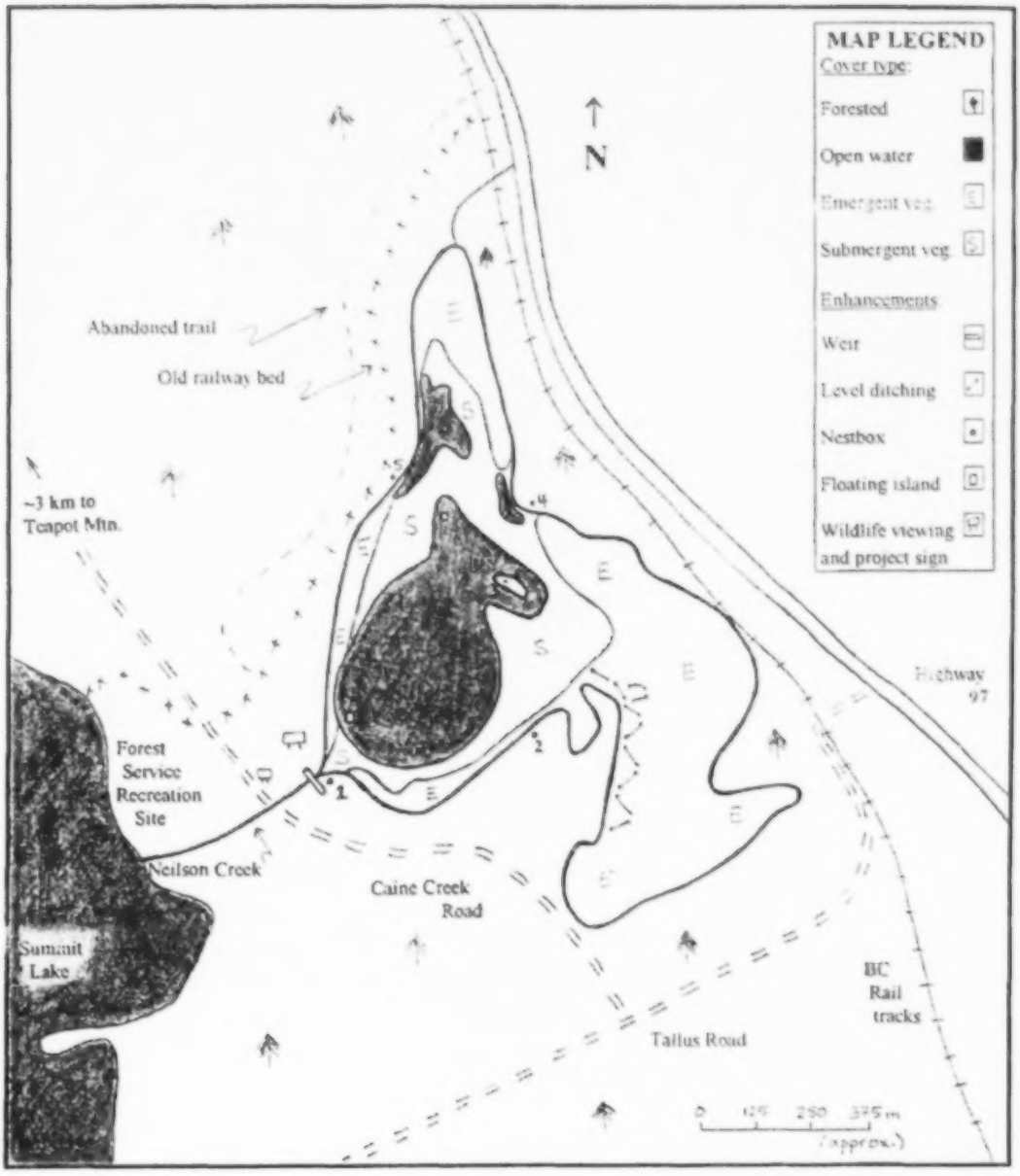


Figure *3*. Sketch plan of Neilson Lake and associated enhancements.

In summer, as much as 30-40% of the open water area (i.e., shallow portions <2 m deep) is occupied by a dense community of submergent vegetation (predominantly waterlilies and pondweeds). Thick mats of floating and rooted sedge occupy 95% of the basin perimeter, with horsetails *(Equisetum spp.)* present in moderate abundance; the remaining 5% is bordered by upland vegetation of grasses and fireweed *(Epilobium angustifoliuni)*. From the lake's edge the bottom drops sharply to 1 m in depth, then slopes gradually to the lake center, attaining a maximum depth of 7 m. A forested 0.5 ha island is present in the northern part of the open water area.

Neilson Lake is within the moist, cool Sub-Boreal Spruce biogeoclimatic zone (Delong *et al.* 1993) and the Nechako Lowland Ecosection (Demarchi 1994). Hybrid white spruce *(Picea engelmannii x glauca)* and subalpine fir *(Abies lasiocarpa)* dominate the surroundings, with some paper birch *(Betula papyrifera)*, trembling aspen *(Populus tremuloides)*, Douglas-fir *(Pseudotsuga menziesii)*, and lodgepole pine *(Pinus contorta)* present. Upland areas have an understory of willow *(Salix spp.)* and other shrubs, with little grass cover.

3.0 PROJECT PLANNING

3.1 *Biological Assessments*

Baseline surveys were conducted to identify the flora and fauna present at the wetland. The initial biological reconnaissance survey of Neilson Lake was conducted by DU on 21 July 1988. Water colour was light brown with pH of 7.5, total acidity of 17.1 mg/L $CaCO_3$, and total alkalinity of 51.3 mg/L $CaCO_3$. Basin profile was described as deep and bowl-shaped with organic substrates greater than 20 cm in depth over gravels. Common plant species (both rooted and floating) were beaked sedge *(Carex rostrata)*, slender sedge *(Carex lasiocarpa)*, spike rush *(Juncus arcticus)*, cattail, and buckbean *(Menyanthes trifoliata)*. Common submergent species included sago *(Potamogeton pectinatus)*, floating-leaf pondweed *(Polygonum natans)*, varied-leaf pondweed *(P. gramineus)*, bur-reed *(Sparganium angustifolium)*, bladderworts, yellow waterlily *(Nuphar variegatum)*, smartweeds, and *Chara spp.* During subsequent site assessments by PWFWCP, water-milfoil *(Myriophyllum sp.)*, coontail *(Ceratophyllum demersum)*, marsh cinquefoil *(Potentilla palustris)*, and bluejoint *(Calamagrostis canadensis)* were also noted.

During the July 1988 assessment, upland nesting by waterfowl was recorded as being limited to the immediate shoreline, due to the lack of grass and the dense understory of the surrounding forest. Overwater nesting sites were restricted to the small cattail area near the proposed dam site. Potential cavity nesting sites for buffleheads *(Bucephala albeola)* and goldeneyes *(Bucephala spp.)* included mature Douglas-fir snags around the shoreline. Insular nesting site capability for upland nesting waterfowl was fair to good on four existing beaver lodges, and one site was observed on the forested island. The irregular shoreline of Neilson Lake had fair but limited breeding-pair nesting site availability.

The DU reconnaissance and subsequent PWFWCP assessments reported observing various dabbling and diving ducks among the fauna using the wetland. Ring-necked ducks *(Aythya collaris)*, scaups *(Aythya marila* or *A. affinis)*, mallards *(Anas platyrhynchos)*, gadwalls *(Anas strepera)*, buffleheads, blue-winged teal *(Anas discors)*, common loons, redheads *(Aythya americana)*, and goldeneyes were observed with broods on the wetland. Extensive Canada geese *(Branta canadensis)* loafing and nesting sign were noted on the forested island, and loafing sign also observed on the lake shore near the outlet creek. Other waterfowl observed at Neilson Lake included mergansers *(Mergus spp.)*, cinnamon teal *(Anas cyanoptera)*, northern shovelers *(Anas clypeata)*, and red-necked grebes *(Podiceps grisegena)*. Beaver, muskrat, Bonaparte's gulls *(Larus philadelphia)*, black terns *(Chlidonias niger)*, tree swallows *(Tachycineta thalassima)*, red-winged blackbirds *(Agelaius phoeniceus)*, red-shafted northern flickers *(Colaptes auratus)* and many other passerines were sighted on various occasions. It is worth noting that Neilson Lake is one of the few known sites frequented by black terns in the Prince George area. Black bear *(Ursus arctos)* and moose *(Alces alces)* sign were observed along the shoreline habitats. Invertebrates observed included water striders (common throughout emergent and submergent zones), snails (common in emergent vegetation and waterlilies), damsel and dragon fly nymphs (common in submergent community), and freshwater shrimp (present in low numbers in submergents).

A 1988 Fisheries Branch reconnaissance survey of Neilson Lake netted 4 rainbow trout *(Oncorhynchus mykiss)* and 1 peamouth chub *(Mylocheilus caurinus)* (Labach 1988). Eleven redside shiners *(Richardsonius balteatus)* were also caught in minnow traps (Westcott 1988).

3.2 *Enhancement Planning*

DU identified Neilson Lake as a potential enhancement site subsequent to their July 1988 reconnaissance survey. This was followed by a thorough engineering survey, including a bathymetric assessment. The engineer's report and preliminary development proposal were completed in September 1988. In February 1990, DU applied for the water licence to authorize the construction of a water control structure at Neilson Lake. Engineering plans for the water control structure were drafted by June 1990 (Appendix A). A Conditional Water Licence on Neilson Lake (#10141) was issued to DU for waterfowl habitat enhancement purposes on 27 December 1991. The improvements approved in the Crown Land Protocol Agreement[1] included a steel-driven weir, 6 nesting boxes, 2 floating islands, 400 linear metres of level ditching and 1 conservation sign. Approval to commence construction was granted by the Water Management Branch on 23 June 1993.

Though DU had done all the necessary project preparations, the enhancement work was delayed by a lack of funds. In March of 1994, at the annual DU/PWFWCP/BC Environment (BCE) meeting regarding interagency wetland enhancement plans, Neilson Lake was identified as a potential cooperative project. During the summer of that year, PWFWCP conducted an assessment of the site and concluded that it met PWFWCP's criteria for enhancement. Further discussions were then held with DU to decide upon project activities and costs. In addition to PWFWCP and DU budgeting project funds for the 1995/96 fiscal, a proposal was submitted to the Habitat Conservation Trust Fund (HCTF) to request additional monetary support for the scheduled activities. Unfortunately, HCTF did not provide funding for the project. It was therefore decided that weir construction would proceed in 1995, but the level ditching and viewing sign activities would be postponed until the following year.

PWFWCP and DU personnel conducted a soil probe survey at 10 locations along the western edge of the fen on 5 December 1994 to assess the depth of organics and identify the ditching area.

[1] As per the Water Act and Licence, tenure is required for the land on which a water control structure is to be constructed and which will be within the subsequent inundation zone. Since DU has an agency policy of not holding land tenure and the construction and inundation area involved Crown lands, a partnership (Crown Land Protocol Agreement) was therefore entered into between the Crown (i.e., BC Environment) and DU (a non-governmental agency). This legally binding document identifies the roles and responsibilities of each agency; in short, the Crown maintains tenure of the land and dedicates the property to conservation (i.e., wetland conservation), while DU is responsible for the maintenance, operation, and management of the water control structure and impoundment area.

Although DU had previously acquired water rights to Neilson Lake in 1991, water licences are canceled if proposed plans are not carried out within 5 years. Upon request, the Water Management Branch granted an extension on the existing Conditional Water Licence (#101401) and the associated Permit to occupy Crown Land (#20104) in January 1995.

To ensure that salmonid fish species were not going to be adversely affected by the development activities planned for the wetland, the Fisheries Branch stipulated that another, more recent fish inventory of Neilson Lake was required prior to weir construction. PWFWCP conducted a reconnaissance-level fish survey from 11 to 12 May 1995 (PWFWCP unpubl. data). Two sinking monofilament gill nets were set for approximately 24 hrs; each gill net consisted of six 50 ft panels with varying mesh sizes (1 inch to 4 inch stretch sizes) connected in random order. Both nets were located in the northern section of Neilson Lake, with net #1 set at the surface and net #2 set at a depth of 1 m to 2.5 m. A total of 27 lake chub *(Couesius plumbeus)* were captured, all in the shallow-end panel (1 inch mesh) of net #1. Since no salmonids were caught, weir modifications to allow fish passage were not necessary.

In addition to obtaining a water licence, it was also necessary to obtain a Ministry of Forests permit to cut or remove timber on the Forest Service District Lot for the purpose of constructing the weir. In July 1995, the Prince George Forest District authorized the developments proposed for the site, including the construction and establishment of the weir and signage on the District Lot. A revised Crown Land Protocol Agreement for the Neilson Lake project - now including the PWFWCP - was endorsed by the Regional Fish and Wildlife Manager (BCE) on 29 June 1995. With the appropriate permits, PWFWCP and DU initiated the enhancement work in September 1995.

4.0 ENHANCEMENTS

4.1 Water Control Structure (variable-crest steel weir)

The instability of the beaver dam which maintained water levels at Neilson Lake prompted the need to establish a permanent water control structure. Construction of a steel-driven, variable-crest weir is expected to conserve the integrity of the wetland for the long term (at least 30 years), and therefore benefit the many wildlife species that rely on this site.

The proposed construction site was 30m downstream (west) of the old beaver dam at the origin of Neilson Creek (Figure 3). Existing road access and sparse vegetation at the site ensured that on-site disturbances resulting from weir construction activities would be minimal.

Weir construction was initiated in September 1995; ice-free water levels are at their lowest in the fall, thereby providing easier building conditions and reducing chances of downstream siltation problems. DU staffing provided the on-site engineering expertise to supervise the construction. Detailed engineering plans for the weir are provided in Appendix A. Photos of the work in progress are included in Appendix B.

Preliminary photos of the lake and proposed dam site were taken on 5 September 1995. Weir construction preparations began the following day. All loose surface material was removed from the site, the weir site centreline was cleared, and steel rails were aligned to guide the vertical steel sheets during installation. The existing beaver dam was left in place throughout construction to maintain Neilson Lake's water level prior to completion of the weir. On 7 September, the vertical guide rails were pounded and supports for the horizontal guide rails were welded. Debris, brush, and organic material between the weir site and the beaver dam were cleared away. An old road crossing housing a box-culvert, about 4 m upstream of the weir site, was excavated to reduce underground seepage through the washed-out log cribbing. Material from this old road and additional soil from an area 30 m north of the weir site was placed 7-8 m in front of the weir, creating a temporary machinery 'walkway' approximately 2 m in height. On 8 and 11 September, an industrial excavator with a special arm fitting was used to drive large sheets of corrugated steel (approximately 2 ft wide and up to 16 ft in length) vertically into the ground. These sheets interlock to provide a tight seal and extend up to 4.5 m into the ground.

From 12 to 15 September, upslope banks were cleared of debris, and two trees were cut for the construction of a log boom. This boom, placed roughly 10 m upstream of the weir, will prevent any floating sedge mats from entering and clogging the weir itself. The ends of the boom were cabled to earth abutments. The temporary walkway was also removed; material from the walkway was returned to the hole north of the weir site. Steel caps were welded to the top of the steel sheets for the overflow channel and the weir crest. Rip rap was placed above and below the control structure to reduce water erosion of the weir. The overflow portion of the weir is 1.5 m above the base of the weir, and its total width is about 13 m. The centre portion (1.1 m) of the weir contains a series of 'stop-logs' which can be removed to control water flows across the weir. A steel plate was welded to the downstream side of the

stop-log opening to serve as an anti-vandalism measure; the plate provided an assurance that if the stop-logs were removed without authorization, water levels would not be affected.

On 18 September, the beaver dam, except for a 7 m centre portion, was removed. The central portion of the beaver dam was left to provide a potential nesting and/or loafing site, and also provide a rooting medium for emergent vegetation. Areas that were disturbed by construction activities were seeded with grass.

A contract inspection was done on 28 September 1995 by PWFWCP and the BCE dam safety officer (Omineca-Peace Region, Water Management Branch). Actual weir measurements were compared to plan specifications, and photos of the completed dam were taken. There appeared to be a slight 'bowing' of the steel but, upon consultation with DU, it was assured that this was due to installation factors and not due to excessive water pressure. The Water Management Branch was satisfied that the weir had been constructed according to the specifications identified in the approved engineering plans, and had confidence in the structural capability of the weir. The weir is expected to last a minimum of thirty years. Photos of the completed weir are included in Appendix B.

After weir construction was completed, Neilson Lake was maintained at its N.O.L. (713.0 m) until late June of 1996. A gradual drawdown (1 m total) was then initiated in preparation for level ditching activities that fall. Drawdowns are accomplished by cutting the welded steel plate blocking the weir outlet down to the desired water level and then periodically removing the stop-logs until this level is achieved, thereby ensuring a controlled release of water without excessive downstream flows or channel scouring. The lowered water levels were sustained throughout 1997 to expose basin soils and allow nutrient release to promote vegetative growth. Water levels are scheduled to be returned to N.O.L after the spring of 1998. Additional drawdowns will likely occur once every 6-10 years, at magnitudes of approximately 0.5 m, to improve diversity and distribution of the emergent community. Drawdowns to 711.5 m can occur for biological reasons, but none are proposed at this time.

4.2 Level Ditching

Level ditching is the creation of a large trench, approximately 6 m wide, in a marshy area which has no or limited open water. The ditching provides potential nesting sites, and open water areas for feeding, brooding and travel corridors. Waterfowl nesting and loafing sites are created when the material removed from the trench is piled along its edge. These piles are seeded with grasses which provide nesting cover. Lowering the water level and digging down to the mineral soil promotes the growth of emergent vegetation such as cattails, thereby providing additional over-water cover and nesting habitat for waterfowl when water levels are again raised. The piles along the trench can also provide potential lodging sites for muskrats.

The large sedge fen at the south end of the wetland was determined to be the most suitable area for enhancement (Figure 3). In June 1996, a 1.0 m drawdown on Neilson Lake's N.O.L. was initiated so that the fen could drain sufficiently to support an excavator on pads during the construction of the level ditching. The last two stop-logs were removed from the weir on 30 July.

The level ditching (about 440 m in length) was completed within the last week of September 1996, under the direction of experienced DU engineering personnel. Initially, an attempt was made to use special floatation devices to support the excavator as work progressed. However, the devices were in disrepair and did not function properly, so logs were used instead. As a consequence, the excavator had difficulty accessing some of the proposed ditching area (i.e., sections where mineral soil was >2 m from the surface). The level ditching area was therefore restricted to portions of the fen where mineral soil was less than 2 m from the surface, resulting in a less sinuous trench. A trench with a greater degree of curvature (i.e., more zig-zag or grid patterned) would have been more favourable since 'switchbacks' in the trench provide better visual barriers between territorial breeding-pairs of waterfowl. Photographs depicting the finished level ditching are included in Appendix B.

While the lake was drawn down in an attempt to establish additional vegetative cover, seeds from locally-picked cattail spikes were dispersed over the exposed soil areas. Residual piles along the trench were also seeded with a grass mix in the fall of 1996, and again in the spring of 1997 to ensure adequate re-growth. In order to allow time for the vegetation to establish itself, water levels will likely not be fully restored until after the spring of 1998.

While the excavator was on site to conduct the level ditching, a section of the outlet creek halfway between Neilson Lake and Summit Lake was also cleared of an old culvert and road crossing which might have caused future blockage problems to the creek.

4.3 Nesting Structures (floating islands and nestboxes)

DU personnel established two floating islands and five nestboxes at Neilson Lake in January 1996 (Figure 3). Floating islands provide supplementary nesting and resting sites for Canada geese and other waterfowl, and nestboxes benefit cavity-nesting waterfowl such as buffleheads and goldeneyes. The islands were standard DU wooden platforms, filled with soil and seeded with a mixture of grasses (Appendix B). These are anchored in place by 80-100 lb cement blocks, attached to the island at opposite corners by steel cable. Floating islands typically last at least ten years before requiring replacement. Four of the nestboxes were standard DU boxes, while the fifth box was a longer, narrower box more suitable for buffleheads (Appendix B). The nestboxes were widely distributed around the lake and situated on different structures (Table 1). Nestboxes typically last seven or more years.

Table 1. Summary of nestbox site characteristics at Neilson Lake, January 1996.

Box no.	Box type	Tree species	Tree status	dbh[1] (cm)	Dist. to water (m)	Box height (m)	Aspect
1	standard	spruce	live	34	10.0	4.9	035°
2	standard	spruce	n/a[2]	n/a	n/a	4	n/a
3	standard	lodgepole pine	live	25	3.9	3.3	175°
4	standard	Douglas-fir	live	76	4.7	3.7	210°
5	bufflehead	balsam	dead	34	4.0	5.6	140°

[1] dbh = diameter at breast height (~1.4 m)
[2] n/a = not available

A thorough assessment of the nestbox and island use by waterfowl was done 15 August 1996 (Rafuse and Corbould in prep.) Both floating islands were essentially void of vegetative growth. Indications of very heavy loafing use by geese and ducks was apparent as the grass was grazed down to <0.5 cm and many fecal droppings were present. Three to four bags (50 L) of soil were added before re-seeding the platforms. Nestboxes showed no use by buffleheads or goldeneyes, but four boxes did have evidence of use by other wildlife: red squirrels *(Tamiasciurus hudsonicus)* in two, an American kestrel *(Falco sparverius)* in one,

and a passerine in another. Incidental observations of waterfowl that day included a pair of common loons with a juvenile. Black terns have also been observed using the site subsequent to the enhancement activities.

4.4 Special Area Designation (Neilson Lake map reserve)

In the spring of 1995, PWFWCP initiated an application to protect the Neilson Lake area as an area of special wildlife concern (as designated under Section 12 of the Lands Act). The objective was to place Neilson Lake and the surrounding area under formal land protection to protect enhancement activities at the site for the long term. Section 12 Map Reserve #957031 was established adjacent to District Lot 1153 for wildlife habitat purposes, effective for a period of 5 years commencing 29 December 1995; re-application to extend the effective term can be made at the time of expiry. The area (84.0 ha) encompasses Neilson Lake and surrounding Crown Land (Figure 2).

4.5 Project Awareness Initiatives (signs and media releases)

Nearby watersport, angling, and hiking opportunities contribute to Neilson Lake's potential high public profile. The Summit Lake Recreation Site, between Neilson Lake and Summit Lake (Figure 3), is the start of the Crooked River Canoe Route and a main access point for Summit Lake. Neilson Lake is also situated adjacent to the Caine Creek Forest Service Road which accesses Teapot Mountain, a popular hiking destination approximately 3 km northwest of the lake. The Neilson Lake site provides an excellent opportunity for the general public to view waterfowl, aquatic furbearers and many other species that reside at, or frequent, the wetland. Neilson Lake's easy access from Highway 97 and close proximity to an existing visitor parking area make it an ideal location for a designated wildlife viewing area.

In the fall of 1995, a project identification sign was placed along Caine Creek Road, near the weir, recognizing the valuable contributions PWFWCP and DU make toward maintaining and improving wildlife habitat in the region (Figure 3). In July 1997, PWFWCP developed interpretive signs to provide visitors with information about the wetland and its wildlife. The sign shelter is located on a little knoll beside Neilson Lake, which provides a view of the

wetland (Figure 3). Directional signs to guide the public to the site are situated on Highway 97 and on Tallus Road. Photos of the signs are given in Appendix B. A copy of the text printed on the interpretive signs is provided in Appendix C.

Media releases providing information about the Neilson Lake wetland enhancement project included articles in local newspapers *Prince George This Week* and the *Prince George Citizen,* and PWFWCP's Spring 1997 issue of Natureline (Appendix D). An information bulletin on the project was also produced by PWFWCP in 1997 (Appendix D).

5.0 PROJECT COSTS

The total cost to conduct all planning and enhancement activities by PWFWCP and DU at Neilson Lake was $70,150, with $40,200 contributed by PWFWCP (Table 2). PWFWCP and DU personnel wages and travel costs associated with working on the project are not included in the cost estimate. In addition to planning, organizing and administering all the project activities, personnel (biologists and assistants) from PWFWCP and DU also performed several field tasks, including conducting the fish inventory and soil probe survey, designing and installing the project sign, constructing and installing the nesting structures, and seeding the appropriate areas.

The majority of funding was required for designing and constructing the steel weir ($44,020) (Table 2). If engineering planning activities - a requirement for constructing any water control structure - are included, weir costs accounted for over 75% ($54,020) of total project costs. A total of $10,365 was spent on activities conducted when the level ditching was created; this included a couple of hours of machinery time required to remove the old road crossing and culvert on Neilson Creek, midway between Neilson and Summit Lakes. Ditching cost approximately $23 per linear metre of ditch. Costs associated with project signage amounted to $4,965. Two copies of each interpretive sign were produced to negate costs with producing another copy in the future; one copy of each sign was erected and the other will be a replacement if vandalism or weathering occurs. The additional copies can also be used at public functions to illustrate an example of our activities.

Anticipated costs associated with the project over the next 30 years will primarily involve personnel time and the requirement of minor materials and supplies to conduct monitoring and

Table 2. Project costs for activities associated with the planning and establishment of enhancements at Neilson Lake.

Activity/Enhancement	[a]Cost	PWFWCP contribution
PLANNING		
- conduct engineering survey	[b] 5,200	
- conduct survey drafting	[b] 1,200	
- develop photo mosaic & conduct soil analysis	[b] 1,400	
- conduct legal work (incl, water licence)	[b] 2,200	
Total	10,000	
STEEL WEIR		
- design and draft engineering plans	5,600	
- construct weir (equipment & materials)	28,720	
- construct weir (engineering supervisor)	9,700	
Total	44,020	28,720
LEVEL DITCHING		
- create ditching (excavator)	[c] 6,265	
- create ditching (engineering supervisor)	3,500	
- seed and fertilize spoil piles	600	
Total	10,365	6,265
ARTIFICIAL NESTING STRUCTURES		
- floating islands (2)	700	
- nestboxes (4)	100	
Total	800	750
SIGNAGE		
- produce & install project sign	500	
- design interpretive signs and shelter	700	
- produce & install interpretive signs	[d] 2,835	
- construct & install shelter	930	
Total	4,965	4,465
Project Total	$70,150	$40,200

[a] Costs do not include PWFWCP and DU personnel (biologists/assistants) wages or travel costs associated with project activities.

[b] Value presented is a best estimate of activity cost in 1995 dollars.

[c] Cost includes machinery time to remove old road crossing on Neilson Creek, downstream of weir.

[d] Two copies of each interpretive sign were produced.

maintenance activities. In addition, some potential costs may be associated with machinery time required to remove debris (placed at the weir by beavers) affecting water levels or flows. These costs will be borne by DU and PWFWCP.

6.0 FUTURE MONITORING AND ENHANCEMENT ACTIVITIES

Since lowering and raising of the water level at Neilson Lake is done to benefit wildlife, and is dependent on habitat response, the water regime schedule must remain flexible. The regime, however, is subject to and dependent upon the Conditional Water Licence issued for the project, and may only be amended upon mutual consent of PWFWCP, DU, and the Fish and Wildlife Branch (BCE). The maintenance, operation, and management of water level controls (in accordance with the Crown Land Protocol Agreement) is the responsibility of DU. Water levels will be monitored and modified in any given year through agreement with the before-mentioned organizations. DU and PWFWCP personnel will monitor water levels during their scheduled project inspections. Monitoring of habitat conditions will be undertaken by DU through biological inspections and on an incidental basis. A standard biological inspection is scheduled to occur once in the first 5 years following construction. Frequency of future inspections will be determined by DU in consultation with PWFWCP and the Fish and Wildlife Branch. Records of inspections and recommendations will be kept by DU and made available upon request. A thorough engineer's inspection will be conducted by DU after 30 years, unless deemed necessary beforehand.

The maintenance and monitoring of nesting structures, as well as further monitoring of waterfowl, aquatic furbearer and other wildlife use of Neilson Lake, will be undertaken every second or third year by PWFWCP as part of its ongoing wetlands enhancement monitoring program.

Loafing structures were not originally placed at the wetland as it was thought suitable protected loafing and resting sites were already available on the island, beaver lodges, and floating sedge mats that were present. However, the heavy use of floating islands as loafing sites - as indicated by preliminary monitoring (Rafuse and Corbould in prep.) - suggest that it may be worthwhile to place loafing logs or platforms on Neilson Lake. Future site assessments will also address the possibility of establishing nesting tunnels to benefit upland nesting species (e.g., mallards).

Depending on the demand for more wildlife viewing opportunities at the site, the development of a trail on the old railway bed that runs along the west side of lake, and/or the construction of a viewing platform, may be warranted. There is good interpretive and educational potential in such an endeavour, and it would complement present recreational and wildlife viewing opportunities in the area.

7.0 CONCLUSION

The work undertaken at Neilson Lake is consistent with PWFWCP goals and objectives, and was an excellent opportunity for a cooperative project between PWFWCP and DU. More importantly, this project's scope offers a range of long term benefits. The enhancements undertaken help promote and sustain ecological diversity in this wetland and provide opportunities for public education, recreation, and enjoyment of its natural resources.

8.0 REFERENCES

In addition to the below stated reports, information provided in this report was compiled from Peace/Williston Fish and Wildlife Compensation Program and Ducks Unlimited (Prince George) project files.

Davidson, P.W. and R. Dawson. 1990. Williston Wildlife Compensation Program management plan, 1990. Peace/Williston Fish and Wildlife Compensation Program Report No. 5. 44pp.

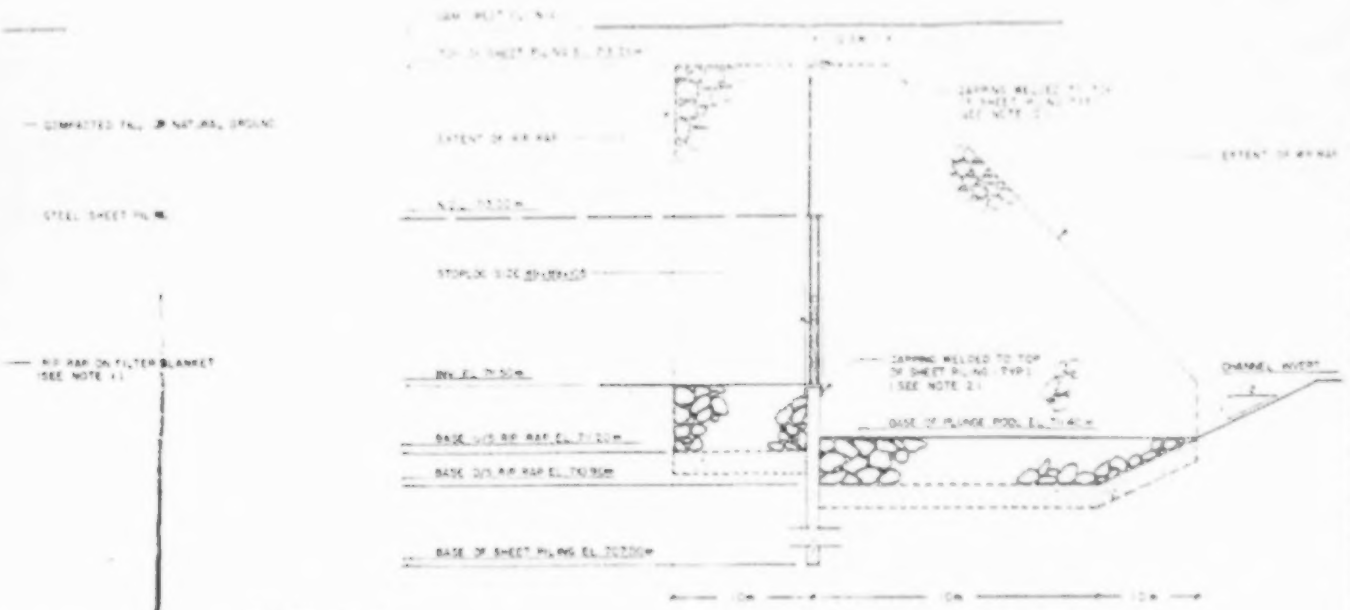
Demarchi, D. 1995. Ecoregions of British Columbia, 4th ed. 1:2,000,000 map.

DeLong, C., D. Tanner, and M.J. Jull. 1993. A field guide for site identification and interpretation for the southwest portion of the Prince George Forest Region. BC Ministry of Forests, Victoria, B.C. 290pp.

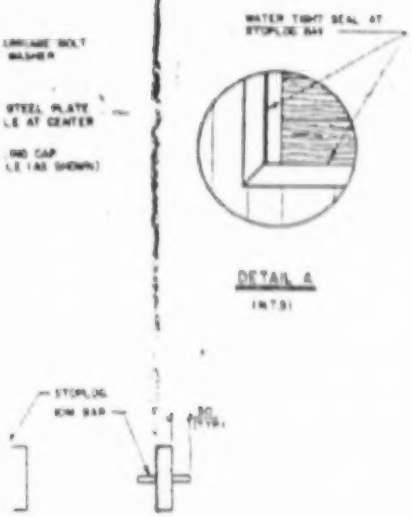
Labach, M.G. 1988. A reconnaissance survey of Neilson Lake. Recreational Fisheries Branch, BC Ministry of Environment, Prince George, B.C. 14pp plus appendices.

Rafuse, E. and F.B. Corbould. In prep. Wetlands Enhancement Program 1994-1996: monitoring and evaluation of enhancements. Peace/Williston Fish and Wildlife Compensation Program, Prince George, B.C.

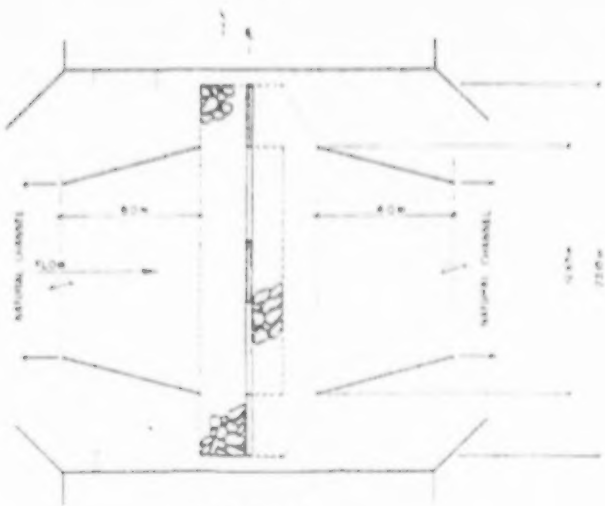
Westcott, R.G. 1988. Summit Lake investigations, Year 2. Fish and Wildlife Branch, BC Ministry of Environment, Prince George, B.C. 11pp plus appendices.



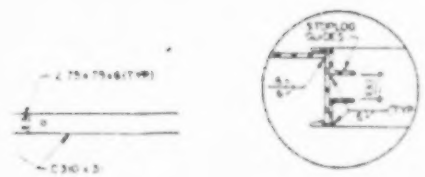
SECTION A-A
(N.T.S.)



DETAIL A
(N.T.S.)



WEIR PLAN VIEW
(N.T.S.)



DETAIL B
(N.T.S.)

NOTES:
1. Rip Rap to be median dia. ____ and to be placed on ____
2. Top capping plate shown is ____ to be welded continuously ____
3. Where the weir is being installed in a dike embankment its alignment shall coincide with the centerline axis of the dike.
4. Stopping pieces may also be fabricated from available WF section and to be used with prior approval by engineer.
5. Stoplogs are to sit free construction grade lumber 2x6, lengths shall be equal to the distance between the inside faces of the guides less 10mm.
6. All dimensions are in metres.
7. A 12mm ø hole shall be drilled 5mm deep from the top of the stoplog 100mm in from the upstream face of the weir.

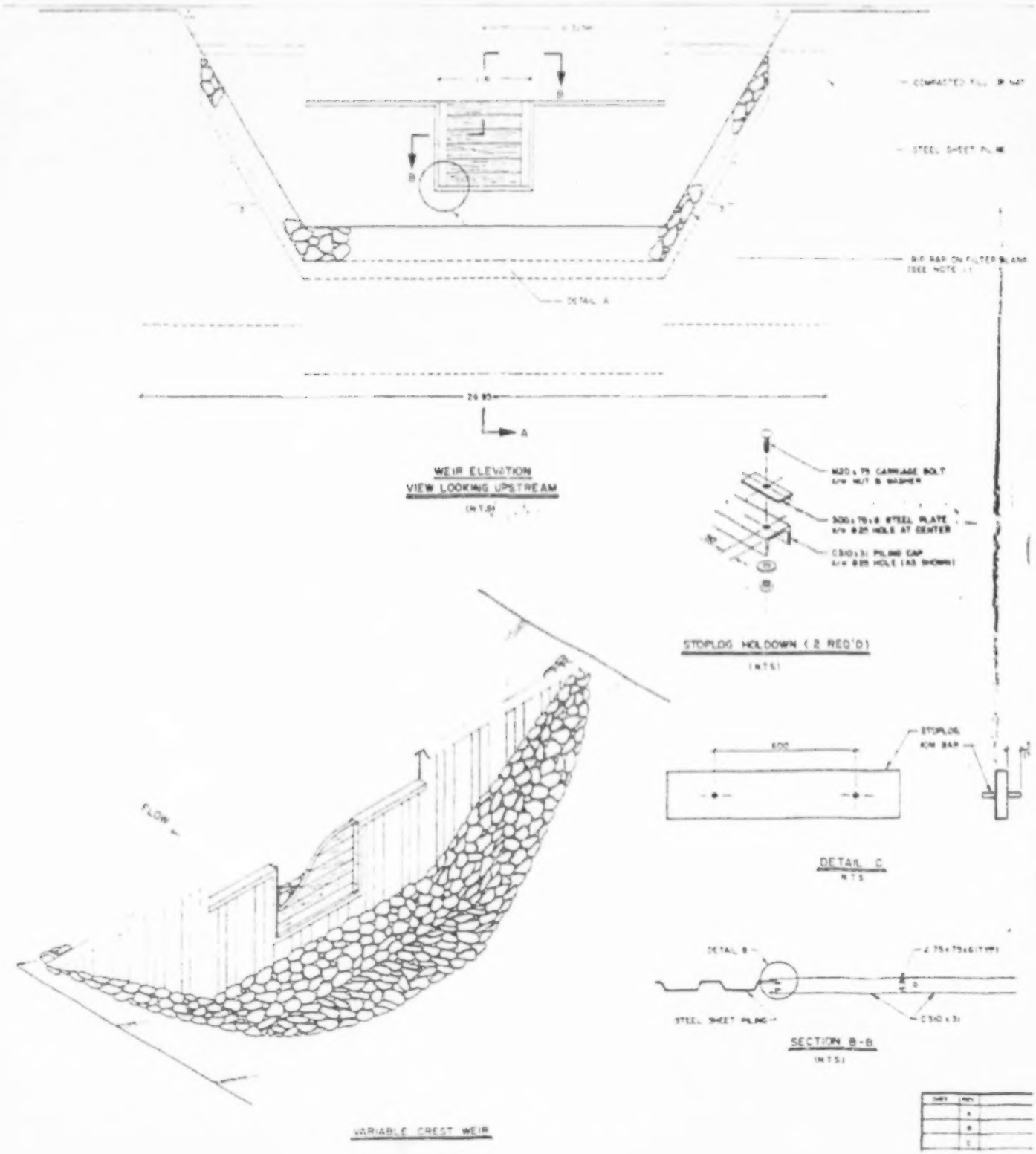
UNIT	REV.	DESCRIPTION	CHANGE #
	A		
	B		
	C		
	D		

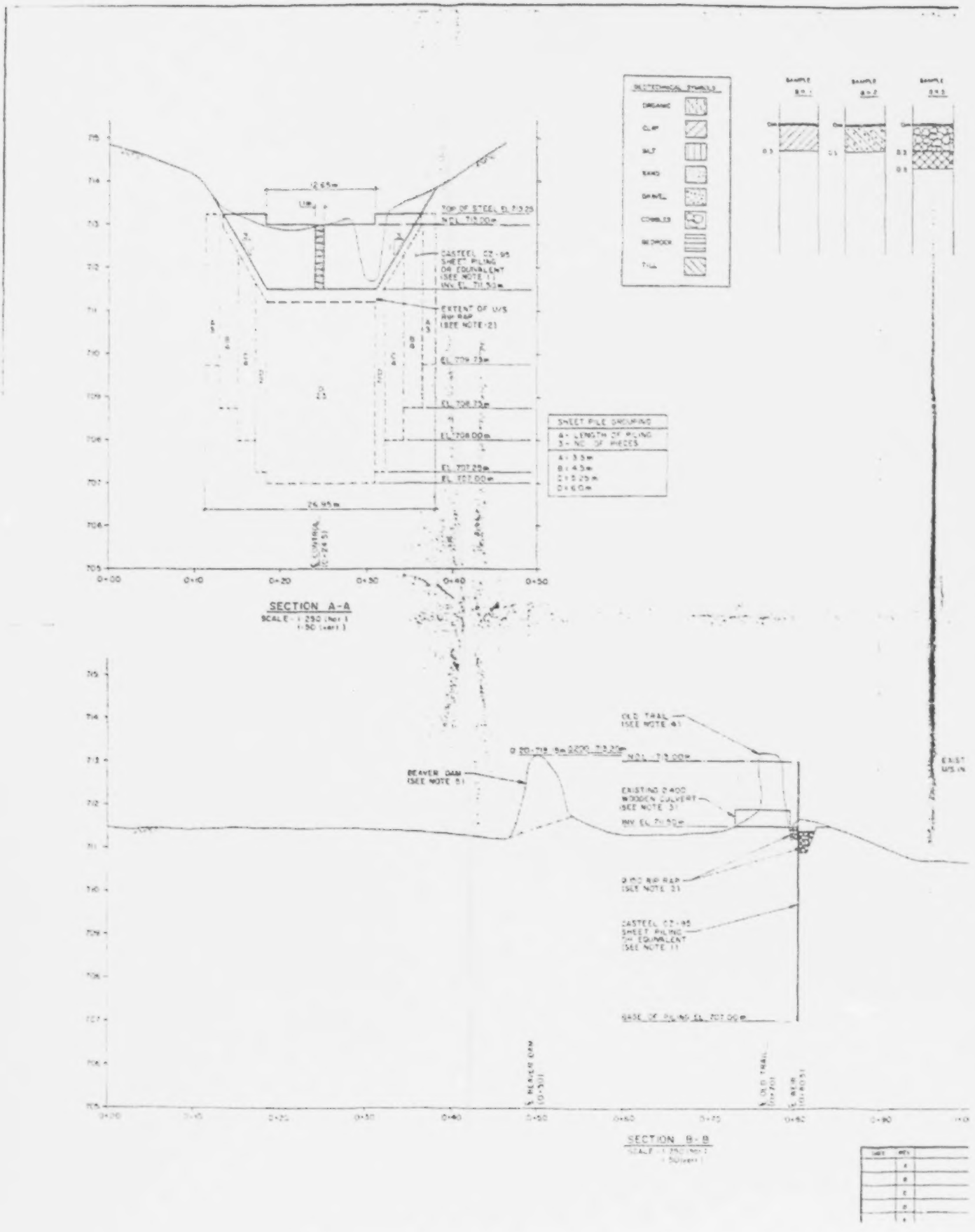
SUBMITTED BY: A.W.
UNIT SUPV'D: LONG
RECOMMENDED BY: ____

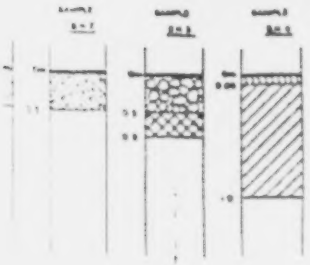
Ducks Unlimited Canada

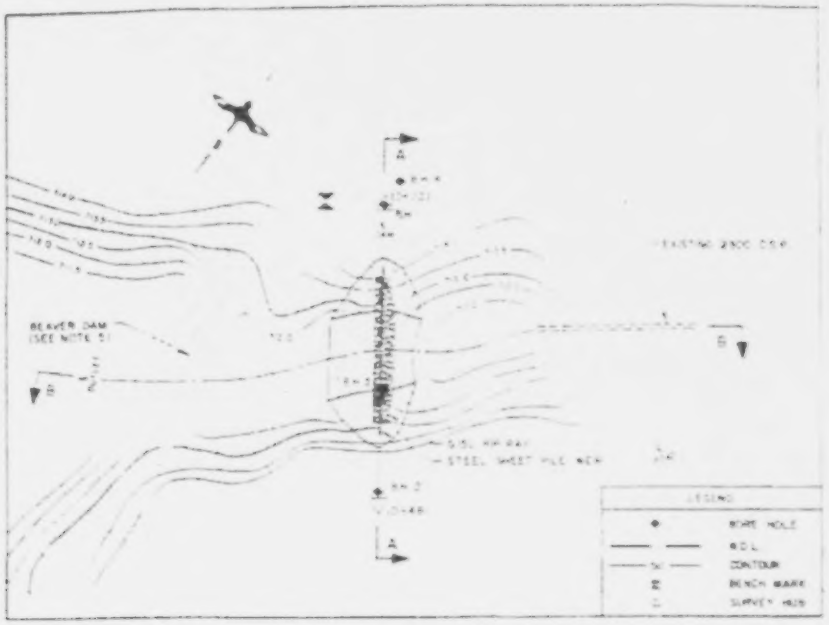
NELSON LAKE
STEEL SHEET PILING

APPENDIX A: Engineering plans for weir construction at Neilson Lake

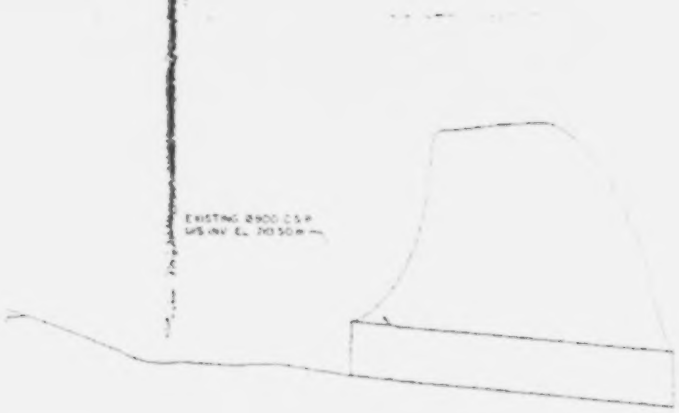



SECTION A-A
SCALE - 1:250 (Hor.)
1:50 (vert.)
SECTION B-B
SCALE - 1:250 (Hor.)
1:50 (vert.)
SHEET PILE GROUPING
A - 3.5 m
B - 4.5 m
C - 5.25 m
D - 6.0 m
CASTEEL CZ-95 SHEET PILING OR EQUIVALENT (SEE NOTE 1)
EXTENT OF U/S RIP RAP (SEE NOTE 2)
TOP OF STEEL EL 713.25
WL 713.00 m
INV EL 711.50 m
EL 709.75 m
EL 708.75 m
EL 708.00 m
EL 707.25 m
EL 707.00 m
26.95 m
12.65 m
BEAVER DAM (SEE NOTE 5)
OLD TRAIL (SEE NOTE 4)
EXISTING 2400 WOODEN CULVERT (SEE NOTE 3)
INV EL 711.90 m
Ø 1200 RIP RAP (SEE NOTE 2)
CASTEEL CZ-95 SHEET PILING OR EQUIVALENT (SEE NOTE 1)
BASE OF PILING EL 707.00 m
EAST WALK IN





SITE PLAN



NOTES

1. WEIR TO BE INSTALLED AS PER DWG. No. 502-42
2. SHEET PILE TO CONFORM TO SPEC. No. 401-42
3. EXISTING 2400 MISSED CULVERT TO BE REMOVED PRIOR TO CONSTRUCTION
4. HAUL TRAIL TO BE REMOVED PRIOR TO CONSTRUCTION
5. BEAVER DAM (S.E. OF CENTRE) @ STA 0+50 TO BE REMOVED AFTER CONSTRUCTION
6. NATURAL CHANNEL BETWEEN STA 0+40 - 0+60 TO BE CLEANED OF DEBRIS

NO.	BY	DESCRIPTION	APPD.
	5		
	4		
	3		
	2		
	1		

DESIGNED BY: M
DATE SURVEY: MAY 83
DRAWN BY: T
CHECKED BY: T
DRAFTED BY: T

Ducks Unlimited Canada

NELSON LAKE

SITE PLAN & SECTIONS

APPENDIX B: Neilson Lake wetland enhancement project photos.

Photo 1. Weir construction in progress (corrugated steel sheets in foreground).

Photo 2. Completed weir (project identification sign in upper left corner).
Photo 3. Completed weir and view of Neilson Lake.

Photo 4 Level ditching.
Photo 5 Standard DU floating island.

Photo 6 Standard DU nestbox.
Photo 7 Buffiehead-type nestbox.

Photo 8 Project identification sign.
Photo 9 Project and wetland interpretive signs.

Photo 1. Weir construction in progress (corrugated steel sheets in foreground).

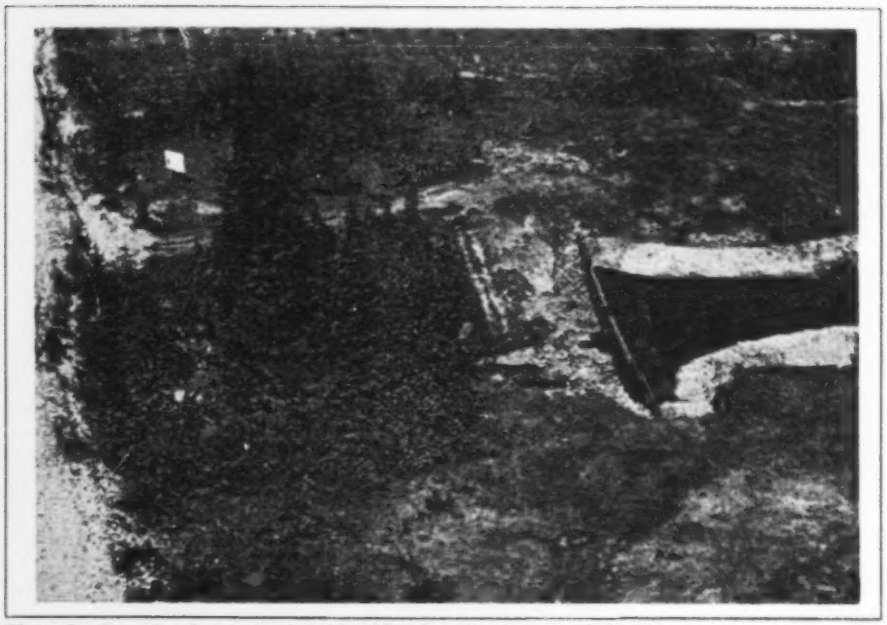


Photo 2. Completed weir (project identification sign in upper left corner).

Photo 3. Completed weir and view of Neilson Lake.

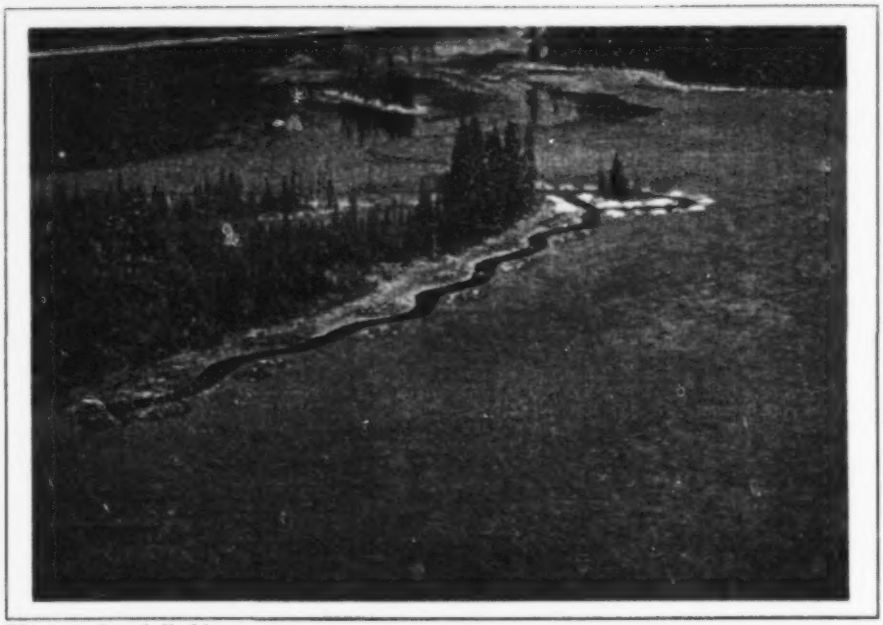


Photo 4. Level ditching.

Photo 5. Standard DU floating island.

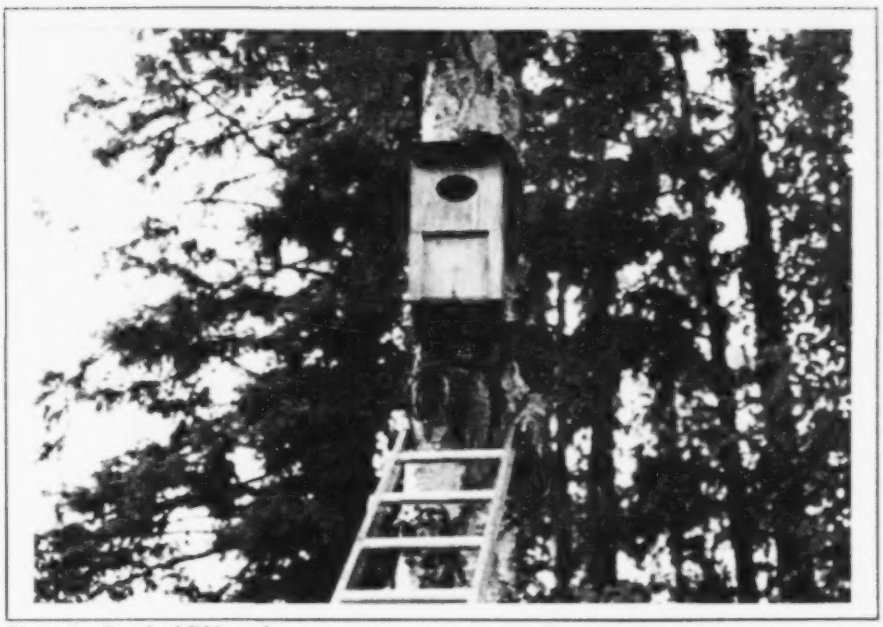


Photo 6. Standard DU nestbox.

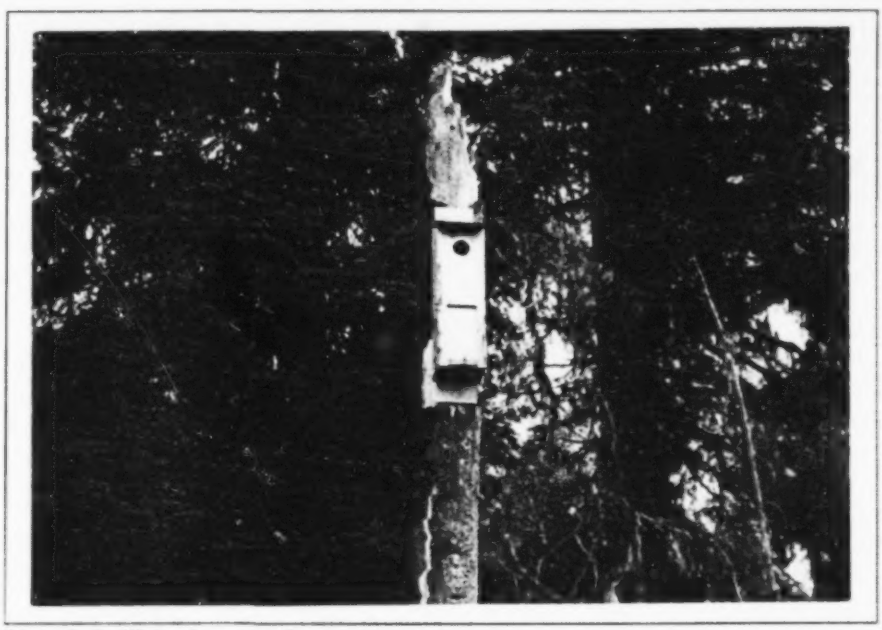


Photo 7. Bufflehead-type nestbox.

Photo 8. Project identification sign.

Photo 9. Project and wetland interpretive signs.

APPENDIX C: Text on the interpretive signs.

Neilson Lake Wetland Conservation Project

Neilson Lake is part of a 48 hectare wetland which provides important feeding and breeding habitat for many wildlife species. In 1994, biologists found that the beaver dam which maintained the wetland's water level was aging. If this dam were to fail, 70% of the wetland could be lost - leaving little more than Neilson Lake.

To protect the lake and its surrounding wetland, biologists from the Peace/Williston Fish and Wildlife Compensation Program and Ducks Unlimited began an extensive project to maintain and enhance the area for its inhabitants. The project involved three stages in which a steel weir, nesting structures and level ditching were developed.

By the fall of 1996, biologists had finished construction here at Neilson Lake. Today, the steel weir maintains water levels in the wetland; nesting boxes and floating islands supplement natural nesting and resting habitat; and in marshy areas of the wetland, level ditching provides open water corridors and nesting sites.

Although construction is finished, the biologists work is not. They will continue to monitor the site to ensure that wildlife populations are benefiting from their work. It is through projects like this, that the Peace/Williston Fish and Wildlife Compensation Program is helping to conserve our wetlands and protect the diversity of wildlife in the Williston Watershed.

A Closer Look at Neilson Lake Wetland

The diverse environment of Neilson Lake Wetland attracts a variety of wildlife species which depend on its moist conditions and rich vegetation. From this location, you may see and hear species which use the open waters and shorelines of Neilson lake.

Here, Red-necked Grebes, Ring-necked Ducks and Buffleheads dive for food and Greater Yellowlegs poke along the shoreline in search of insects. In the distance, Canada Geese and Mallards can often be seen preening and resting on floating islands while Tree Swallows and Black Terns dance above the water in search of insects. From further reaches of the wetland, where Muskrats, Blue-winged Teals and scaups feed, the familiar song of Red-winged Blackbirds resonates of the water.

Those interested in further exploration of the wetland will likely see many more species which thrive in and around this aquatic habitat. We encourage you to explore, however, please respect those that live here! Be quiet, move slowly and keep your distance so that you do not disturb these wetland residents.

APPENDIX D: Media releases regarding the Neilson Lake wetland enhancement project.

Article in *Prince George This Week* (September 10, 1995).
Article in *Prince George Citizen* (November 26, 1996).
PWFWCP Natureline (Spring 1997 issue).
PWFWCP Information Bulletin (Spring 1997).

Construction supervisor David Matias surveys plans for a steel weir that will replace an abandoned beaver dam between Neilson Lake and Summit Lake north of Prince George. The project will preserve water levels in a wetlands area that's home to waterfowl, loons, muskrat, amphibians, and moose. Neil Mayert of Twin Rivers Developments is operating the backhoe. Photo David Mah

Wetlands conservation project underway

Construction began this week on a project to save a threatened wetlands area north of Prince George.

Ducks Unlimited is building a steel weir to replace an abandoned beaver dam at the mouth of a creek which flows from Neilson Lake into Summit Lake.

Without a replacement for the dam, water levels would drop one to two metres, says area biologist Brad Arner.

"(The weir) maintains the water in the marsh."

The area provides habitat for waterfowl, loons, muskrat, amphibians, and moose. Arner says the marsh has some good wildlife values that are worth saving. Since the marsh is close to a forest service campground, Arner adds there's an opportunity to develop public hiking and viewing trails.

Primarily a feeding, molting, and nesting area, the site is also valuable because it's a stopover point for birds during annual migration; In addition to the weir, the project will include nest boxes for bufflehead and goldeneye ducks, and floating islands for birds to rest on.

Ducks Unlimited is in charge of planning and monitoring of the project while close to three-quarters of the $40,000 cost is coming from the Peace-Williston Compensation Program, a perpetual fund created by B.C. Hydro and the Ministry of Environment for fish and wildlife enhancement projects.

Nov, 26/96 *Citizen*

Ducks Unlimited raises $90,000

by PAUL STRICKLAND
Citizen Staff

The $90,000 the local Ducks Unlimited chapter netted at its fall banquet and auction Friday will be used for worthy projects in the region, says the organization's membership services representative.

About 330 people attended the annual event at the Coast Inn of the North, Keith Connors said Monday.

"All money raised in B.C. stays in B.C."

New projects are being started, and old ones need maintenance, he said. Altogether there are 700 Ducks Unlimited projects in the province.

One local example is a marsh enhancement project at Nielsen Lake, near Summit Lake. Ducks Unlimited did it in conjunction with the Peace-Williston Compensation Fund, sponsored by B.C. Hydro.

Much of the money raised at Friday's banquet was from raffles and live and silent auctions, Connors said.

Among the art objects offered were a Ken Ferris original watercolor painting titled Back in the Saddle, which sold for $4,500, and a hand-carved woodpecker by Tom Schwartz of Mud River, which sold for $2,000.

Also auctioned were some interesting trips, such as fishing trips, a Whistler ski trip and a chance to see the Three Tenors in Vancouver on New Year's Eve.

The $90,000 raised, still an unofficial figure, is a little higher than last year's total, Connors said. The amount is the second highest in Canada from Ducks Unlimited chapters. Only Calgary's Ducks Unlimited group raised more, and it draws members from a much larger city than Prince George.

"It's a record we're pretty proud of," Connors said.

Natureline

Spring 1997

Neilson Lake Wetlands Enhancement

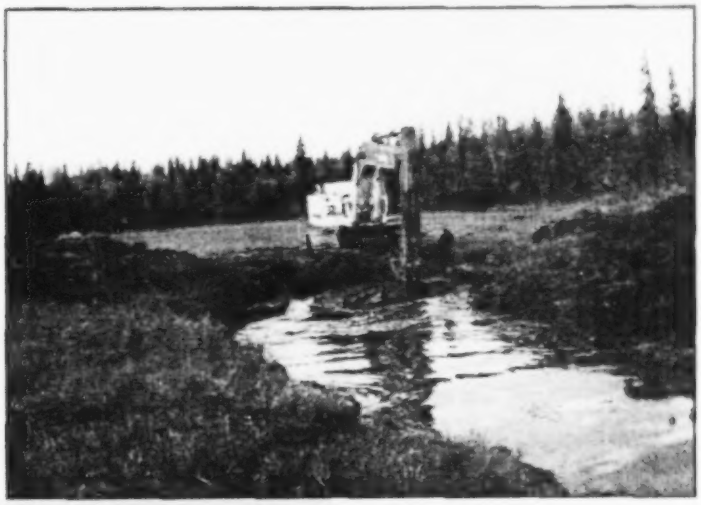
Neilson Lake, 45 kilometres north of Prince George, is an important wetland for waterfowl, aquatic furbearers (muskrats and beavers) and other wildlife species. To enhance the wetland, we constructed a steel weir that will stabilize water levels and provide a means of manipulating the level to best benefit the animals. We also installed two floating islands and five nestboxes to provide nesting sites for Canada geese and cavity-nesting ducks, such as goldeneyes and bufflehead. In addition, level ditching will be conducted in the fall of 1996 to increase nesting and rearing habitat for waterfowl and to provide potential lodges for muskrats.

Information Bulletin

Neilson Lake Wetlands Enhancement

PEACE/WILLISTON FISH & WILDLIFE COMPENSATION PROGRAM

Objective: To maintain the existing wetland habitat of Neilson Lake and to enhance it where possible.



A An excavator is used to dig a long ditch at Neilson Lake wetlands. The spoil piles on either side of the ditch were later seeded with grasses to provide additional nesting cover and forage for wildlife.

Biologists with the Peace/Williston Fish and Wildlife Compensation Program (PWFWCP), in partnership with Ducks Unlimited (DU), have conducted an extensive wetlands enhancement project at Neilson Lake.

The Neilson Lake wetland supports many different wildlife species, including Canada geese, ducks, loons, beavers, muskrats, moose and several species of songbirds and shorebirds. Its diverse vegetation and habitats make it popular with waterfowl and aquatic furbearers (muskrats and beavers).

During the inventory stage of the project, PWFWCP biologist Fraser Corbould monitored the area to determine which wildlife species used the site and their patterns of use. The survey also determined that the wetland area was maintained by an old beaver dam. If the dam were to breach, approximately 70 percent of the wetland would be lost, greatly reducing the habitat available for the resident wildlife. Based on a detailed engineering survey of the site by Ducks Unlimited, Corbould and DU biologists were able to develop an enhancement plan.

Enhancement was divided into three stages. A dam or weir structure was needed to maintain the integrity of the wetland and to provide a means of manipulating the water level to optimize the vegetation conditions for the wildlife. Level ditching would be undertaken to provide travel corridors and potential feeding and nesting sites. Finally, nest boxes and floating islands would supplement the available nesting and resting habitat.

BC Environment

BC hydro

In the summer of 1995, the PWFWCP and DU installed a steel weir to replace the old beaver dam. To build the weir, the loose surface material was removed at the site and interlocking sheets of corrugated steel were driven into the ground. The engineers cut an opening in the middle of the weir and fitted it with stop logs to enable the biologists to manipulate the water levels. Large rocks were placed at the base of the structure to prevent any potential water erosion.

The lowering and raising of the water levels will be conducted to best benefit the wildlife. When the water level is lowered, emergent vegetation, such as cattails and sedges, will grow on the newly exposed soil. Once the vegetation has established itself, the water level can again be raised to create feeding and shelter areas for many wildlife species and "over water" nesting habitat for other species, such as scaups, redheads and ring-necked ducks.

Submergent vegetation, such as pondweeds, smartweed, bladderwort and water lily are abundant in the open-water areas and are a food source for many waterfowl species. Both submergent and emergent types of vegetation also provide microhabitats for water invertebrates which are fed upon by numerous wildlife and fish species.

During construction of the weir, the old beaver dam was kept intact to hold back the water. When the weir was complete, one portion of the beaver dam was retained to provide a potential nesting and resting site and the remainder was removed.

The next stage of the project involved level ditching to enable waterfowl and aquatic furbearers to make better use of the marsh area adjacent to the lake. In 1996, an excavator was used to dig a 400-metre long ditch in the marsh to increase the feeding sites and movement corridors. "Spoil piles" created from the material that was removed were then seeded with grass to provide additional nesting sites along the edge of the ditch. Because ducks and geese are territorial, the ditches were formed in a zig-zag pattern to maximize the number of separate nesting and feeding sites.

The waterfowl at Neilson Lake also benefit from several artificial nesting and loafing structures installed at the wetland. Two floating islands are used primarily by Canada geese. Five nestboxes were installed for cavity-nesting waterfowl such as bufflehead and goldeneyes.

"It's too early to say whether our enhancements will mean an increase in any specific animal population, but we know that we have conserved this wetland for the many species that use it. We've also seen that the floating islands and nest boxes are being readily used and may need to be supplemented in the near future," said Corbould.

Monitoring of the wetlands will continue for many years to come. Staff from PWFWCP and DU make regular visits to the site to ensure that the weir and the enhancements are functioning properly. Neilson Lake and the surrounding area have received special land status, meaning that the area is to be managed for wildlife habitat purposes. A wildlife viewing/information sign will also be placed at the site to draw attention to the area and to help increase public understanding of the enhancement project.

The Peace/Williston Fish and Wildlife Compensation Program is a joint B.C.Hydro and B.C. Environment initiative to enhance and protect fish and wildlife within the Williston and Dinosaur watersheds in northeastern British Columbia.

For more information, please contact:

Wildlife Biologist
Peace/Williston Fish & Wildlife Compensation Program
1011 Fourth Avenue
Prince George, B.C. V2L 3H9
Phone: 250-565-6135
Fax: 250-565-6629